Space Solar Power Concept Technology Maturation
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Output from Working Group Session: SPG & PMAD

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Table 1

List of Revolutionary Technologies: (non-prioritized)

1) III-V PV on polyimide substrates
2) Room temperature reliable superconductors
3) Efficient thermal scavenging for extra power production
4) High efficiency, higher operating temperature laser conversion
5) Solar pumped laser
6) Kilo-volt solar arrays
7) High temp. quantum dot PV
8) Passive/local/distributed sun tracking
9) Cell/laser on same chip

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Table 2

Detailed description and assessment of technologies from Table 1. List the impact to the SSP goals and the other related technologies:

1) **PV with the light weight of thin film and the efficiency of III-V**
2) **Lossless conductors can lead to reduced voltage requirements and huge mass savings**
3) **Can provide extra power with little mass impact and can help thermal control**
4) **Higher conversion laser efficiency reduces PV mass and thermal system mass and enables integration of PV and diode.**
5) **Eliminates much of the PV array and PMAD and can reduce complexity.**
6) **Arrays in the kilo-volt range are required to keep current levels and cable mass at reasonable levels**
7) **A potential path for much higher efficiency thin film solar cells**
8) **Reduces complexity and stiffness requirements on concentrator PV arrays**
9) **Puts PV and laser conversion on same chip and enables optical transmission of large amounts of power with greatly reduced mass**

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Table 3

Consensus on the future direction of research and development to solve the challenges of SSP: Near Term: Develop overall efficiency train for various architectures. Operation and control of an extremely large spacecraft. Reliability should be considered during early design. Component to component tests should be fairly early in the program eventually leading to an end to end test. Thermal effects can drive the design and testing. High voltage testing of all applicable components. Far Term: Are current conversion technologies able to meet SSP goals? Look at more advanced concepts i.e.. Quantum dot cells, solar pumped lasers. III-V PV on polyimide, solid state thermal engine. Look at volume production of various components. Watch out for breakthrough technologies.

Discussion Items

- Laser transmission
  - Push electric to laser efficiency of diodes---now at 50%
  - Voltage level—low voltage/many diodes
  - Low voltage implies multiple pointing problems
- Pumped laser to pumped laser
- Voltage level---cable mass pushes to high voltages---number of smaller arrays
- Diffraction losses may limit how small laser levels may be
- Do laser beams add or is there an interference loss?
- How high a voltage can we run arrays at?
  - 1000 to 4000 volts

More Discussion

- Parallel architecture may have single point failures at short circuit
- Need a modular PMAD system with reasonable failure rates
- Sunlight in space to power on the Earth grid is our goal---the fewer conversions the better
- Is there room for some sort of thermal conversion? (solid state thermal engine)—either primary or scavenging?
- Is power transmission using light more efficient than conventional wiring?—less massive?
- Light weight by itself is not enough for SSP. We need light weight AND high efficiency AND producibility
- Does the laser option offer significant advantages over the micro-wave option?
- Do new heat rejection schemes apply on an extremely large scale?
- Is there a role for IR filters on reflectors in the PV system?